Designers as determinants for aesthetic innovation

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Designers as Determinant for Aesthetic Innovations

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Abstract

The innovation literature states that scientists are core ingredients in creating technological innovations. This paper investigates whether the hiring of a designer generates aesthetic innovations by a firm. Further we investigate what the level of design knowledge of the receiving firm means for the firms? absorptive capacity, in terms of turning the hiring of the designer into aesthetic innovations. We explore a unique dataset containing information on firms, their hiring of designers and aesthetic innovations measured by design applications (design patents). Our findings show that hiring a designer does increase firms? likelihood of producing aesthetic innovations. Secondly, firms with prior experience of aesthetic innovations are more likely to apply for design registrations. Thirdly, there is a positive moderating effect of firms with prior experience of generating aesthetic innovations on the effect of hiring a designer on aesthetic innovation outcome.

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Abstract

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Keywords: Designer, aesthetic innovation, design rights, labor mobility

1. Introduction

On June 28th 2007, just 1 day before Apple introduced their first legendary iPhone, 92 design patents, covering the design, shape and icons used in the iPhone, was applied for[1]. Apple did not only wish to protect the technicalities of the iPhone with patents, but were also aware of the importance of the unique aesthetic innovation they had created - an aesthetic innovation covering the shape and design of the product. The aesthetic appearance of the iPhone would distinguish the phone from any other phone on the market, and consumers would therefore be able to differentiate the iPhone from competition by the design. The design patents Apple filed protected the unique aesthetic innovation they had created. Apple's design patents later became the IP at stake, together with a number of utility patents, in a series of over 50 court suits between Apple and Samsung worldwide. In the US court cases[2] the jury found that Samsung willfully infringed Apple's designs[3] and patents[4], and Samsung were found to pay over USD 1 billion in damages to Apple (a verdict that was later changed). The outcome of the case led to Samsung, on the subsequent day, losing 7,5% of their stock value - essentially, exemplifying the importance of aesthetic designs as appropriation mechanism. It is not only Apple and Samsung that has seen the light in aesthetic innovations, using aesthetic innovations has become a more common appropriation method among many firms during the last decade. Aesthetic innovations can be measured by the use of design registrations (Filitz, Henkel et al. 2014), and the last ten years US firms have more than tripled their number of design patents, outperforming the growth rate in both trademarks and patents[5].

[1] Designview: www.tmdn.org/accessed the 24th February 2015
[2] Apple Inc. v. Samsung Electronics Co., Ltd. et al, Case No. 5:2011 cv01846. And Apple Inc. v. Samsung Electronics
2CApple Inc. v. Samsung Electronics Co., Ltd. et al, Case No. 5:2011 cv01846. And Apple Inc. v. Samsung Electronics
Co. Ltd. et al, Case No. 5:2012 cv00630
[3] Design patents covering icons such as the "home button, rounded corners and tapered edges" US D593087 and "On-Screen Icons" US D604305.
[4] US Patent No. 7,469,381, US Patent No. 7,844,915 and US Patent No. 7,864,163
[5] http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=US

The aesthetic innovations are valuable to firms for a number of reasons: firstly they lower search costs for consumers as consumers can recognize the product in the market and differentiate it from competition, secondly the design right can be used as enforcement in regards to counterfeit products and cheap knock-offs. In such situations design rights are easier to use for example by the custom authorities as they can be observed by looking at the product and no technical knowledge is needed to analyze whether it is an infringement (as is the case with patents). Thirdly, the costs of protecting an aesthetic innovation by a design registration do not come anywhere near the costs that firms must pay to obtain a patent right. Depending on the country the costs are between 1/10 and 1/5 of the price of a patent and in some jurisdictions there is no examination of the design right (e.g. in EU), why the registration process is fast and easy, and does not require many resources from the applicant firm.

However, if aesthetic innovations are valuable for firm operations and also cheap to protect why does not all firms start producing them? What does it take for a firm to be able to create aesthetic innovations? From labor mobility studies in the innovation literature we know that scientists are core ingredients in creating technological innovations, and that the move of a scientist/engineer from one firm to another has implications for both the receiving and departing firms' technological innovation output (Almeida and Kogut 1999, Hoisl 2007, Agarwal, Ganco et al. 2009, Marc Gruber, Dietmar Harhoff et al. 2013). In this paper we set out to explore, whether the story we see with engineers and technological innovations are the same when we consider mobility of designers and aesthetic innovations. Specifically, we investigate whether the hiring of a new designer generates more aesthetic innovations than a matched firm, which does not hire a designer. Further we investigate what the prior experience with aesthetic innovations of the receiving firm means for the firms' absorptive capacity, in terms of turning the hiring of the designer into aesthetic innovations.

We explore a unique and detailed dataset containing information on firms, their employees, their new hires and their aesthetic innovation activities, measured by design registrations. We use a matched sample technique and compare firms that hire a designer versus the non-hiring firms. Our findings show that hiring a designer does increase the likelihood of aesthetic innovations. Secondly, firms with prior experience of aesthetic innovations are more likely to apply for design registrations. Thirdly, there is a positive moderating effect of firms with prior experience of generating aesthetic innovations on the effect of hiring a designer on aesthetic innovation outcome.

Our contribution to the current literature is two-fold. First, we add to the scarce literature on aesthetic innovations. Even though the term has been around for a long time (Christensen 1995) the determinants for the occurrences and large N empirical studies on this type of innovation is scarce. This paper is the first, as far as we are aware, to explore design registrations as output measure for aesthetic innovations and link it to firms' behavior in terms of aesthetic innovations. Second, we add to labor mobility research by empirically investigating the mobility of designers and their importance for aesthetic innovation outcome.

The remainder of the paper is structured as follows. Section 2 reviews the empirical setting and presents the theory section containing the hypotheses on labor mobility and prior experience, as well as the moderating effect of prior experience on hiring designers. Section 3 introduces the unique dataset and the matching process. Section 4 presents our findings. The final section outlines the conclusion.

2. Aesthetic innovations and their determinants

The types of innovations and their determinants have been a main topic in the innovation literature, most researched is that of technological innovations (see for example recent review on determinants for technological innovations in Ahuja, Lampert et al. 2008), but also innovations such as organizational or administrative innovations have received attention (e.g. Aiken and Hage 1971, Collins, Hage et al. 1988, Hage 1999, Ruef 2002), or innovations understood as diffusion, and adaptations of new behaviors in organizations (Hage 1999). The aesthetic aspects of product innovations has primarily been studied in marketing literature (e.g. Urban, Carter et al. 1986), even though it has close ties to the technical aspects of a product (Christensen 1995). Few studies have focused on aesthetic innovations as earlier work treated aesthetic innovations as an external layer to that of the technological innovation (e.g. Clark 1985).

In contrast, more recent literature focus on the link between the aesthetic innovation and the technological innovation as a central research topic (Christensen 1995, Sanderson and Uzumeri 1995, Salter and Gann 2003, Eisenman 2013). One example is the recent contribution by Eisenman (2013) who argues that aesthetic innovations are an important part of firms' innovative activities. He argues that *"visible design attributes, such as color, shape and texture, allow producers to explain what their products do and how best to use them, to excite users in a way that generates sales, and to extend the basic functionalities of their products by highlighting their symbolic meanings."* (Eisenman 2013 p.332), and thereby places the strategic use of aesthetic innovations as a key challenge for the commercialization of technological innovations. Production of technological innovations alone, with no reference to design, shape, color and texture, might be of less interest for the consumer/buyer, as it does not trigger affect (Verganti 2006), which is found to generate higher sales (Bloch 1995, Gemser and Leenders 2001, Hertenstein, Platt et al. 2005).

In the literature focused on aesthetic innovations, the sources of innovations identified and empirically tested are still limited: certain industries are more prone to create aesthetic innovations than others (Filitz, Henkel et al. 2014). The properties of the innovation process in regards to aesthetic innovations is different from that of the process of inventing technological innovations (Tran 2010), and collegial network and teamwork are core to the aesthetic innovation process (Salter and Gann 2003). However, the studies are conducted based on case studies of one industry or firm, which limits the generalizability of the results (e.i. Salter and Gann 2003, Tran 2010).

On this backdrop we will turn our attention towards investigating which role designers play in generating aesthetic innovations. First we highlight the characteristics of designers and their working methods, to give reasoning to why designers would be particularly prone to generate aesthetic innovations and contribute to the value of firms.

2.1 Designers and their approach in problem solving

Previous literature highlights that the problem-solving processes of designers are different from that of scientists (e.g. Lawson 1979, Cross 1982). Lawson (1979) reports that designers learn about a problem through explorative learning mechanisms of trial and error of various solutions, whereas scientists tries to identify the causal mechanisms fundamental for understanding the problem at hand. Scientists' approach to problem solving has been labelled the traditional rational problem-solving paradigm, whereas designers' approach to problem solving is labeled design-thinking (Glen, Suciu et al. 2014). Schön (1983) observed that in the process of design making, learning by doing triggered new stimuli which had a positive influence on the aesthetic innovative process, and that designers easily navigated through processes which could be characterized as ill structured. The cognitive process in the two approaches, design-thinking vs. rational problem solving, is therefore fundamentally different. Recent literature have highlighted that other educational programs, than that of designers, could benefit from using the designers' cognitive approach to problem solving in order to spur more innovative behavior of students and help them to conduct more complex problem solving (Glen, Suciu et al. 2014).

Hereunder, one of the main factors in which designers differ from using the rational paradigm is that of combining the exploration and exploitation phase. As Glen (2014 p.657) puts it: *"Although the design process may begin with some initial specifications, clients and customers often do not know what they want until they can see what they can get. This reinforces the solution-based, iterative nature of the design process."* The designers also differ from scientists in the methodology used in the development process, designers often rely on observational and ethnographic methodologies (Kelley 2001, Beckman and Barry 2007). Designers are therefore expected to be able to conduct a different set of innovative activities, using a different approach than that of scientists. They solve innovation tasks that are related to shapes, context and product forms, and the effort of building symbols and visual communications into a product to be commercially valuable (Buchanan 1992).

In this respect, we therefore argue that it could be expected that designers, because of their mindsets and working methods, can generate value in firms' innovation activities, in particular in relation to generating aesthetic innovations. Below we will argue that if this is the case, we will see firms that hire designers having a higher likelihood of generating new aesthetic innovation than firms that do not hire. We will argue this based on a combination of knowledge base literature and labor mobility literature.

2.3 Mobility of designers and their contribution to aesthetic innovative output

Knowledge is identified as a highly important resource to the firm (Grant 1996, Kogut and Zander 1996). The firm innovate through a combination of existing knowledge and knowledge new to the firm (Kogut and Zander 1992), relying on external sources of knowledge to provide input on new ideas, experiences and opportunities. One source of external knowledge to the firm is that of hiring new employees, integrating their knowledge into the firm (Lippman and Rumelt 1982, Coff 1997). This is often referred to as 'Learning by hiring' (Singh and Agrawal 2011). Firms use the hiring process to acquire new technological competencies and the capabilities to enter new technological areas (Rosenkopf and Almeida 2003, Palomeras and Melero 2009, Singh and Agrawal 2011), and as a way of introducing new types of products to the market (Rao and Drazin 2002, Dokko and Rosenkopf 2010). Multiple studies focus on technical inventors and the impact of their mobility on the patenting activities of both the leaving and hiring firms (see e.g. Almeida and Kogut 1999, Hoisl 2007, Agarwal, Ganco et al. 2009). The knowledge acquired while working for the old employer is brought to the new employer through the hiring process (Pakes and Nitzan 1983, Kim and Marschke 2005), granting the hiring firm access to new knowledge previously unavailable internally. Similarly to this mechanism, which allows the firm to gain technological knowledge through the hiring of inventors (e.g. Almeida and Kogut 1999), the firm can increase its ability to develop new aesthetic innovations by hiring new employees skilled in generating these. Our first hypothesis is therefore:

H1: *Labor mobility of designers is associated with a higher probability of the hiring firm to produce new aesthetic innovation output.*

While the process of learning-by-hiring can be used to gain access to new types of knowledge, this knowledge may not be directly applicable by the hiring firm. The literature on organizational learning has clearly established that the ability of a firm to acquire and apply new external knowledge is limited by the firm's own experiences and expertise (Nelson and Winter 1982). Learning by doing is a core mechanism for the creation of a knowledge base within a firm (Argote 1993), which can then later be exploited by the firm to generate new innovation (Levitt and March 1988). This is closely related to the concept of absorptive capacity (Cohen and Levinthal 1990), which states that the firm cannot implement new knowledge without prior experience to allow the firm to interpret and understand this new knowledge. Thereby the firm that is already experienced with developing aesthetic innovations and registration of the associated design rights would be more likely to develop these.

H2: Prior experience of the firm with aesthetic innovations is associated with a higher probability of producing new aesthetic innovation output.

Engaging in learning-by-hiring to complement the existing knowledge of the firm is often focused on the exploration of distant knowledge, rather than enforcing existing competencies (Song, Almeida et al. 2003), using a broad search scope to develop new capabilities (Danneels 2002) rather than reinforcing existing capabilities. A firm with no prior experience in aesthetic innovations will engage in a more distant search process when seeking to develop the necessary capabilities to begin developing aesthetic innovations. The hiring of a designer with experience in aesthetic innovation will increase the likelihood of the firm to develop aesthetic innovations, as the knowledge diffused through the learning by hiring process can provide the missing piece of knowledge required as input in the innovation process (Bessen and Maskin 2009).

Likewise, firms already experienced with aesthetic innovation can benefit from the process of learning-by-hiring. The knowledge and experience required to develop aesthetic innovations can be seen as a core asset to the firm. In this case, the new knowledge brought to the firm through the hiring process can be seen as a complementary asset (Teece 1986), which in combination with the core asset of the firm can create new value.

While both experienced and inexperienced firms can benefit from implementing new knowledge in their innovation process, the overall impact differs between these firms. When firms, not experienced with aesthetic innovation, attempt to implement the new knowledge gained in the hiring process, it is not without difficulties. The new, complex knowledge must be adapted to, and implemented in, existing routines and processes (Hoetker and Agarwal 2007). In comparison, firms who are experienced with aesthetic innovation will be using the new knowledge to re-enforce existing capabilities (Teece 1986). Since these firms have the necessary absorptive capacity to utilize the new knowledge (Cohen and Levinthal 1990), this process is likely to be less disruptive.

H3. Firms with experience in aesthetic innovation, hiring a designer is associated with a higher probability of developing a new aesthetic innovation, when compared to a firm without experience in aesthetic innovation.

3. Data and Method

Data on design registrations collected from OHIM[6], DKPTO[7] and German DPMA[8] made by Danish firms in the period 2000 to 2010 form the core of our data. We draw upon three sources of design registrations, as firms operating only in the domestic market tend to register only in Denmark, whereas firms with a more international focus register internationally. The data is retrieved from OHIM's DesignView database, covering designs registered in the European Union, DKPTO's PVSOnline database, covering designs registered in Denmark and German designs retrieved from the German online database DPMA. These databases use a proprietary internal firm identifier, which is incompatible with the identifier used by Statistics Denmark, the supplier of our firm and individual-level data, why a manual merging process was initiated based on firm names. In collaboration with DKPTO the registrants of these design rights are identified and a unique firm identifier is associated with each registrant using the CVR registry of Danish firms. A total of 10,595 OHIM design registrations, 1,725 Danish design registrations and 521 German design registrations were identified and matched to firm identifiers. After having matched the data to the available registry data from Statistics Denmark, we are left with 10,243 OHIM designs, 1,665 Danish designs and 521 German designs, a total of 12,429 designs accounted for by 1,457 firms. Design registrations made by individuals without a firm identifier are omitted, as these cannot be matched to the firm registry used.

Data on design registrations is merged with firm and individual-level data provided by Statistics Denmark. The data on individuals and firms consist of a combination of employer-employee register data from Statistics Denmark (IDA) from 2000 to 2010, thus containing a panel structure. The employee register data contains, among other things, information on the person's

6 The Office for Harmonization in the Internal Market
7 The Danish Patent and Trademark Office
8 The national German design registrations (registrations that are applied covering the German jurisdiction)

employment (industry, job function, primary job, secondary job, degree of unemployment etc.). The employer data contains information on industry, whether the company is an exporting company or not, the size of the firm, geographical location etc. Most importantly this provides data on the end-of-November employment[9]. The data is structured in a panel, with annual firm data on revenue, productivity, exports, industry and number of employees as key variables, merged with individual level data that allow us to track the employment history of each individual within the period of observation. This provides us with 119,990 observations divided between 15,886 unique firms in Denmark from 2000 to 2010.

From the data we see that on average there are 6,026 designers in the Danish workforce in one year and 430 new designers are hired by Danish firm on average per year. Designers mostly engage in manufacturing industries and the industries registering most design rights per firm are manufacturing and trade & transport.

3.1 Variables

Dependent variable:

Our dependent variable *Design rightst+3* is a binary variable taking on the value 1 if a firm registers a design right three years after potentially having hired a designer. A design is defined as: *"(a) 'design' means the appearance of the whole or a part of a product resulting from the features of, in particular, the lines, contours, colors, shape, texture and/or materials of the product itself and/or its ornamentation;"*[10] (Article 3 p. 5)

[9] Statistics Denmark registers the affiliation of an individual once a year in November, whereby we do not observe mobility within the year.

[10] COUNCIL REGULATION (EC) No 6/2002 of 12 December 2001 on Community designs (can be found at http://oami.europa.eu/en/design/pdf/reg2002_6.pdf accessed 27th of February 2015).

Explanatory variables:

Hire designer is a binary variable taking on the value 1 if a firm has hired an employee who worked as a designer in his/her previous employment and 0 if not. The hire of a designer is measured in November of a given year. The variable is used in the matching procedure and to test for hypothesis 1.

Design right registration experience is a binary variable taking on the value 1 if the firm has prior experience in registering design rights and 0 if not. The variable is measured from when the firm is first observed in the data, the first possible year being 2000.

Control variables:

The control variables are chosen based on the idea to find other variables than our explanatory ones that could explain a firm's likelihood to register design rights. We include variables concerned with the firm's combination of job functions of employees, the design registration history of the firm and firm specific variables. That is, we control for the share of employees with a law related job function in a firm, the share of employees with an engineering job function in a firm, hires of engineers by the firm, hire of other new employees than designers and engineers by the firm, the share of designers in the firm in the previous year, a variable indicating whether the firm has registered designs in the previous year, firm age, firm size, whether the firm is an exporting firm or not, whether the firm is located in the capital area or not, industry dummies (Manufacturing, construction, trade transport, ICT and financial) and year of matching.

3.2 Method

A potential pitfall in the econometric analysis includes endogeneity problems. The question is if firms hire designers with the sole purpose of obtaining more design rights or not. We control for this by applying a matched sample method where we match firms on previous design rights tendencies, among other variables. More specifically, firms who have hired a designer are matched with other similar firms who have not hired a designer. That is, the dependent variable used in the matching procedure is *hire designer* and the following variables are used as explanatory variables: A binary variable for whether the firm has registered any design rights in the previous year, industry (exact 2 digit industry code), number of designer employees in the previous year and firm size. The matched sample is created for the years 2004, 2005, 2006 and 2007 respectively and under the restriction of the firm not having hired a designer during the three previous years or three following years.

After creating the matched sample we are left with a sample of 1,078 firms and are able to test if hiring a designer has a positive effect on a firms rate of aesthetic innovations (design rights). The regression results of the matched sample can be found in the appendix.

We use the matched sample and econometric analysis is carried out using logistic regression estimation, as the dependent variable, *design right t+3,* is a binary variable. Robust standard errors are applied in all regression and both the coefficient estimates and odds ratios are presented in results table.

4. Findings

This section presents the summary statistics, the results of the regression estimations and robustness checks.

4.1 Summary statistics

Table 1 presents the descriptive statistics. The final sample size consists of 1,078 firms; where half of them have employed a designer at time t. 3.2% of the firms register a design right in time t+3. Of the 1,078 firms 3.3 % have previous experience in registering design rights. On average the share of employees with a designer job function is 1% of the total number of employees, with a maximum of 9.6 %.

Table 1: Descriptive statistics

Descriptive statistics (N=1,078)				
Variable	Mean	S.D.	Minimum	Maximum
Design right t+3	0.032	0.175	0	1
Hire designer	0.500	0.500	0	1
Have design right exp.	0.033	0.180	0	1
Share of employees w. law job	0.001	0.007	0	0.176
Share of employees w. engineer job	0.021	0.068	0	0.602
Hire engineer	0.196	0.397	0	1
Other hires	0.949	0.220	0	1
Log firm size	4.362	1.382	0	9.559
Share of designers t-1	0.009	0.037	0	0.440
Design right t-1	0.037	0.189	0	1
Manufacturing	0.397	0.490	0	1
Construction	0.043	0.202	0	1
Trade & transport	0.232	0.422	0	1
Financial	0.178	0.383	0	1
Export firm	0.719	0.450	0	1
Capital area	0.316	0.465	0	1
Matching year	2005	1.017	2004	2007

Table 2 presents the correlations of the dependent, independent and control variables. Both the variable *hire designer* and *have design right experience* are correlated with registering design rights in time t+3, which is a first indication of our hypothesized relationships to be confirmed. The variable *design right t-1* is highly correlated with *have design right experience*, which is expected as both variables are explaining firms previous design experience, however, this means that *design right t-1* is not included as a control variable in the models that also contains the explanatory variable *have design right.*

Table 2: Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Design right t+3	1																
(2) Hire designer	0.0743*	1															
(3) Have design right exp.	0.4096*	0.0723*	1														
(4) Share of employees w. law job	0.0429	0.0273	0.0402	1													
(5) Share of employees w. engineer job	0.0185	0.0520	-0.0133	0.0726*	1												
(6) Hire engineer	0.0447	0.1099*	0.0384	0.0110	0.3086*	1											
(7) Other hires	0.0177	0.0548	0.0431	0.0256	0.0394	0.1144*	1										
(8) Log firm size	0.0481	0.0203	0.0706*	0.0461	-0.0437	0.3262*	0.3420*	1									
(9) Share of designers t-1	-0.0043	0.0124	-0.0163	-0.0194	0.2338*	0.0084	-0.0703*	-0.1136*	1								
(10) Design right t-1	0.3577*	0.0196	0.5098	0.0353	-0.0150	0.0392	-0.0214	0.0302	-0.0035	1							
(11) Manufacturing	0.0705*	0.0000	0.1235	-0.0796*	-0.0442	0.0775*	0.0761*	0.0605*	-0.0600*	0.1316*	1						
(12) Construction	-0.0118	0.0000	-0.0392	-0.0221	-0.0212	0.0462	0.0490	0.0563	0.0040	-0.0414	-0.1713*	1					
(13) Trade & transport	0.0014	0.0000	-0.0043	-0.0525	-0.1352*	-0.1437*	-0.0624*	-0.0310	-0.0632*	-0.0265	-0.4459*	-0.1160	1				
(14) Financial	-0.0146	-0.0000	-0.0595	0.0677*	0.3019*	0.0698*	-0.0463	-0.0595	0.2209*	-0.0401	-0.3777*	-0.0983	-0.2558*	1			
(15) Export firm	0.0774*	-0.0186	0.0933*	-0.0009	-0.0505	0.0484	0.0707*	0.0907*	-0.0783*	0.0791*	0.3218*	-0.2151*	0.0062	-0.2483*	1		
(16) Capital area	-0.0086	0.0658*	-0.0487	0.1269*	0.0542	0.0566	0.0489	0.1428*	-0.0689*	-0.0280	-0.3155*	-0.0153	0.0516	0.1734*	-0.0451	1	
(17) Matching year	-0.0362	0.0000	0.0126	0.0422	-0.0153	0.0203	0.0397	-0.0342	-0.0550	-0.0226	0.0092	-0.0020	-0.0390	0.0141	0.0021	0.0311	1

(*) significant at 5%

4.2 Results

Table 3 presents the results of the logistic regression estimations and includes both the coefficient estimates and odds ratios. Model (1) solely contains control variables. Model (2) includes the explanatory variable for whether the firm hired a designer or not. Model (2) shows that hiring a designer has a significant and positive effect on the likelihood of registering a design right three years later. The odds ratio suggests that a firm is 2.6 times more likely to register a design right at time t+3 if a firm hires a designer. Hence, hypothesis 1 is supported by the empirical findings.

Model (3) includes the explanatory variable for whether the firm has prior experience in registering design rights or not. The results of model (3) show that having experience with registering design rights has a positive and significant effect on the probability of registering a design right in time t+3. The odds ratio suggests that a firm is 37 times more likely to register a design right in time t+3 if it has prior experience in registering design rights. Hence, the results of the logistic regression estimation support hypothesis 2.

Model (4) shows the results of the logistic regression estimation when including the interaction of the two variables for whether the firm hires a designer and whether it has prior experience in registering design rights. Model (4) shows that having experience in registering design rights without hiring a designer has a positive and significant effect on the probability of registering a design right in time t+3. Furthermore, if the firm has both experience in registering design rights and hires a designer, the probability of registering a design right in time t+3 is higher. The odds ratio suggests that a firm is 69 times more likely to register a design right in time t+3 if it has both experience in registering designs and hires a designer, compared to not having experience in registering design rights and not hiring a designer. We use a Wald test to test having design right registration experience only against having both design right registration experience and hiring a designer. We find that we cannot reject that the effect of the two variables is the same.

Table 3: Results of logistic regressions

Regression estimation results

Dependent variable: *design right t+3*	Model (1)		Model (2)		Model (3)		Model (4)	
	a. Logit	b. Odds ratio	a. Logit	b. Odds ratio	a. Logit	b. Odds ratio	a. Logit	b. Odds ratio
Hire designer			0.958**	2.607*				
			(0.44)	(1.14)				
Have design right exp.					3.610***	36.98***		
					(0.49)	(18.13)		
No hire designer x have design right exp.							2.653***	14.19**
							(0.99)	(14.10)
Hire designer x no have design right exp.							0.379	1.461
							(0.48)	(0.69)
Hire designer x have design right exp.							4.230***	68.73***
							(0.62)	(42.74)
Share of employees w. law job	41.344**	9.02550e+17*	40.614**	4.34845e+17*	33.374**	3.11958e+14*	31.280**	3.84323e+13*
	(16.83)	(1.51859E+19)	(15.88)	(6,90683E+18)	(16.44)	(5.12727e+15)	(15.62)	(6.00316e+14)
Share of employees w. engineer job	2.040	7.690	1.771	5.878	1.570	4.808	1.782	5.942
	(2.32)	(17.83)	(2.24)	(13.14)	(2.21)	(10.63)	(2.16)	(12.82)
Hire engineer	0.142	1.152	-0.004	0.996	0.137	1.147	-0.066	0.936
	(0.51)	(0.59)	(0.52)	(0.52)	(0.57)	(0.65)	(0.57)	(0.54)
Other hires	0.121	1.129	0.129	1.138	-0.310	0.733	-0.301	0.740
	(1.19)	(1.34)	(1.08)	(1.23)	(1.17)	(0.86)	(1.16)	(0.86)
Log firm size	0.146	1.157	0.115	1.122	0.016	1.016	0.008	1.008
	(0.20)	(0.23)	(0.21)	(0.23)	(0.20)	(0.21)	(0.20)	(0.21)
Share of designers t-1	-0.799	0.450	-2.227	0.108	0.295	1.343	-0.421	0.656
	(3.51)	(1.58)	(4.59)	(0.50)	(3.65)	(4.90)	(4.05)	(2.657)
Design right t-1	3.067***	21.48***	3.105***	22.32***				
	(0.46)	(9.81)	(0.46)	(10.21)				
Manufacturing	17.040***	25,143,368.2***	15.710***	6,647,809.6***	15.135***	3,740,584.6***	14.936***	3,065,559.0***
	(3.11)	(78,190,004.5)	(2.88)	(19,161,364.7)	(2.43)	(9,087,493.9)	(1.68)	(5,135,921.8)
Construction	17.721***	49,662,149.9***	16.428***	13,627,879.0***	15.813***	7,371,756.9***	15.643***	6,216,644.4***
	(3.46)	(171,744,793.7)	(3.25)	(44,236,366.1)	(2.77)	(20,447,519.9)	(2.12)	(13,203,857.6)
Trade & transport	17.328***	33,519,740.6***	15.972***	8,643,783.3***	15.059***	3,468,602.9***	14.791***	2,653,035.4***
	(3.20)	(107,257,932.7)	(2.98)	(25,724,525.0)	(2.46)	(8,527,907.6)	(1.74)	(4,625,953.7)
Financial	17.169***	28,592,015.6***	15.953***	8,474,142.4***	15.327***	4,532,233.5***	15.143***	3,773,281.4***
	(2.96)	(84,565,574.6)	(2.79)	(23,615,990.6)	(2.25)	(10,181,704.9)	(1.59)	(5985599.6)
Export firm	1.541**	4.669*	1.664**	5.278*	1.480*	4.392	1.573**	4.823*
	(0.78)	(3.66)	(0.80)	(4.12)	(0.78)	(3.41)	(0.78)	(3.74)
Capital area	-0.128	0.880	-0.154	0.857	0.177	1.194	0.130	1.139
	(0.47)	(0.415)	(0.48)	(0.41)	(0.52)	(0.62)	(0.54)	(0.61)
Matching year = 2005	0.641	1.898	0.688	1.990	0.582	1.789	0.737	2.090
	(0.69)	(1.31)	(0.71)	(1.41)	(0.66)	(1.18)	(0.67)	(1.404)
Matching year = 2006	0.952	2.592	1.031	2.803	0.967	2.629	1.041*	2.831
	(0.66)	(1.709)	(0.67)	(1.87)	(0.61)	(1.62)	(0.63)	(1.79)
Matching year = 2007	-0.900	0.406	-0.872	0.418	-1.211	0.298	-1.107	0.331
	(0.81)	(0.329)	(0.82)	(0.34)	(0.85)	(0.25)	(0.86)	(0.28)
Constant	-23.510***		-22.742***		-20.563***		-20.635***	
	(3.62)		(3.41)		(2.89)		(2.19)	
Observations	1,078	1,078	1,078	1,078	1,078	1,078	1,078	1,078
$\chi 2$ -test	$\chi 2(16) = 243$	$\chi 2(16) = 243$	$\chi 2(17) = 227$	$\chi 2(17) = 227$	$\chi 2(16) = 360$	$\chi 2(16) = 360$	$\chi 2(18) = 619$	$\chi 2(18) = 619$
R2	0.26	0.26	0.28	0.28	0.30	0.30	0.31	0.31

Robust standard errors in square brackets ; (*) significant at 10%; (**) significant at 5%; (***) significant at 1%

To further investigate the effect of the interaction term on the probability of registering a design right in time t+3 a graphical plot of the marginal effects is produced. Figure 1 shows the predictive marginal effects of the interaction term. The effect of hiring a designer without having design registration experience is positive but not significant. That is, our results do not support that for firms with no experience in aesthetic innovation, hiring a designer is associated with a higher probability of developing new aesthetic innovations. However, for firms having experience in registering design rights the effect of hiring a designer is associated with a significantly higher probability of registering design rights in time t+3.

Figure 1: Predictive marginal effects

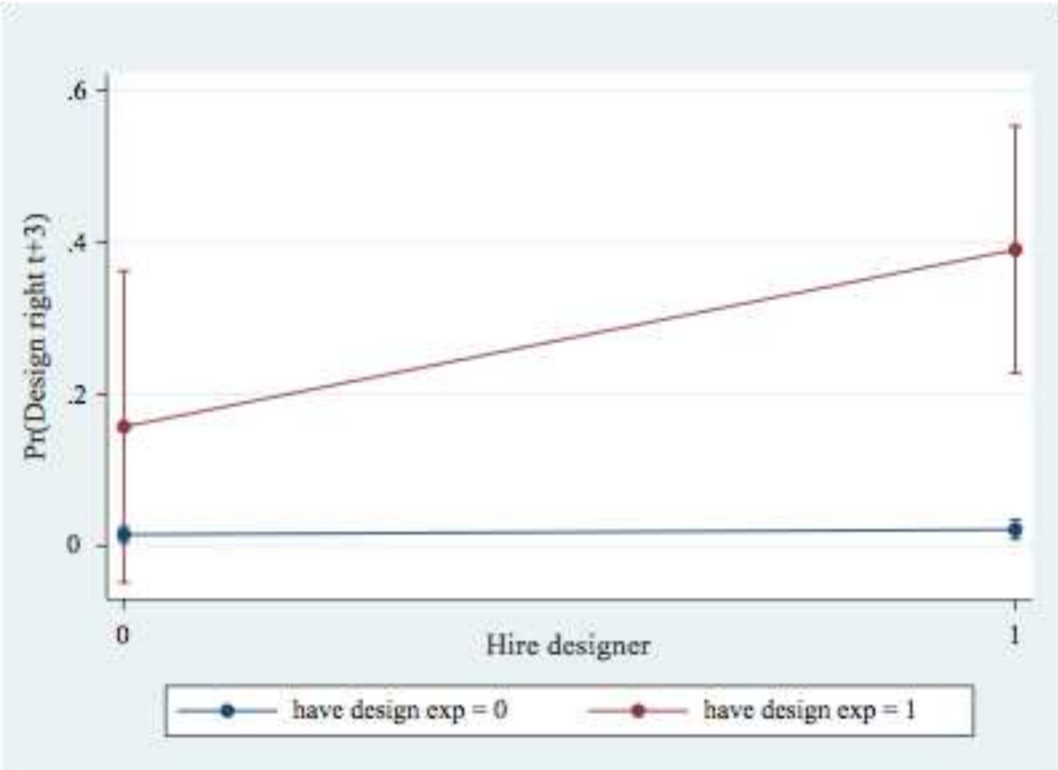


Figure 2 shows the contrasted marginal effect of hiring a designer for firms with and without prior experience in registering design rights. The figure shows that the effect on the probability of registering a design right in time t+3 from hiring a designer is not significant unless the firm does have prior experience in registering design rights, however only at a 10% significance level. This result is in favor of hypothesis 3, however only weakly.

Figure 2: Contrasted predictive marginal effect of hiring a designer

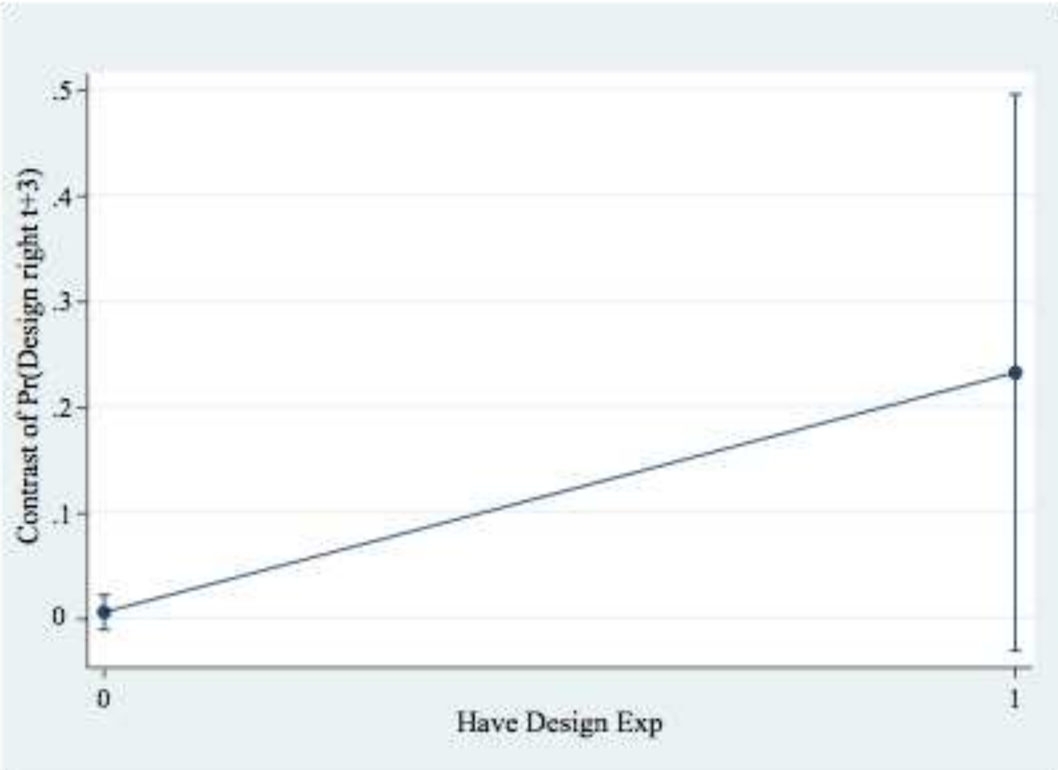
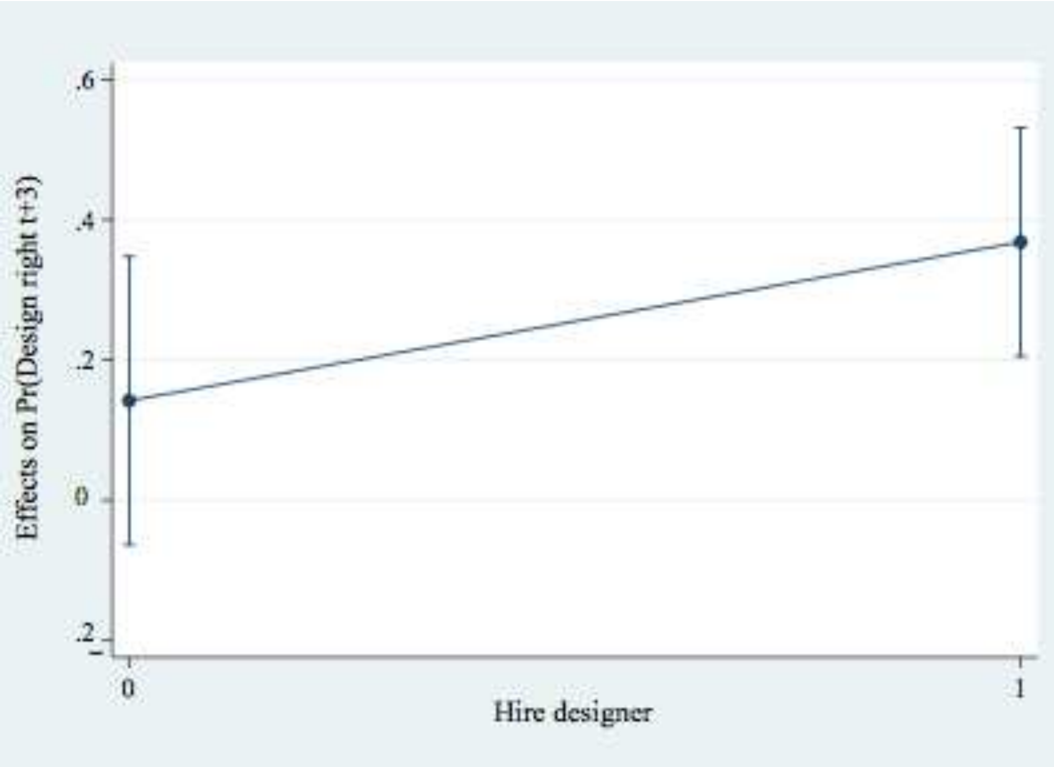


Figure 3 shows the average marginal effect of hiring a designer on the probability of registering a design right in time t+3 when the firm does have prior experience in registering design rights. The figure shows that hiring a designer has a significantly positive effect on the probability of the firm to register a design right in time t+3. That is, when a firm changes from not having to having design registration experience the effect of hiring a designer is positive and significant. This result provides further evidence for hypothesis 3.

Figure 3: Average marginal effects of hiring a designer when *have design right exp. = 1*.



4.3 Robustness checks

As robustness checks we first introduce *design right t+1* and *design right t+2* as dependent variables and furthermore carry out negative binomial regressions using *number of design rights t+1, number of design rights t+2* and *number of design rights t+3* respectively as the dependent variable. The findings hold when applying a negative binomial model and using *number of design rights t+3* as the dependent variable. Further, our results hold when using *design right t+1* as the dependent variable and partially when using *design right t+2* as the dependent variable. The same is true when applying the negative binomial model.

5. Conclusion

This paper sets out to investigate whether the firms hiring of a designer generates aesthetic innovations and what the level of design knowledge of the receiving firm means for the firms' absorptive capacity in terms of turning the hiring of the designer into aesthetic innovations.

By exploring a unique dataset on firms, labor mobility of designers and firms' design registrations we find a positive effect from hiring a designer and from the firm having design knowledge on the probability of registering design rights. However, in order for the firm to fully benefit from hiring a designer, through a higher probability of registering design rights, the firm needs to have prior experience in registering design rights. That is, if the firm does not have the necessary absorptive capacity, the firm will not be able to exploit the full potential of the designer and therefore the probability of registering design rights in the three-year period after will not be increased.

As the reader is probably aware by now, this paper is work in progress. We are in the process of writing a deeper discussion of the results presented in the paper as well as developing the theoretical linkage between labor mobility literature and design-thinking in the hypotheses building further. We will implement these elements (and probably more) before the DRUID conference.

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7. Appendix

A1. Results after matching process

Table 4: Regression estimation using matched sample

Regression estimation results using matched sample	
Dependent variable: *Hire designer*	Model (1)
Log firm size	0.031
	(0.04)
Share of designers t-1	0.824
	(1.69)
Acc. no. design rights t-1	0.203
	(0.32)
Matching year = 2005	-0.02
	(0.21)
Matching year = 2006	0.007
	(0.19)
Matching year = 2007	0.009
	(0.20)
Constant	-0.156
	(0.26)
Observations	1,078
$\chi2$ -test	$\chi2(6) = 1.09$
R2	0.0007

Robust standard errors in square brackets ; (*) significant at 10%; (**) significant at 5%; (***)